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Rabeya Akter

Lecturer, Department of Fishery
Biology and Genetics, Faculty of
Fisheries and Ocean Sciences,
Khulna Agricultural University,
Khulna, Bangladesh

Md. Mahub Alam

4th Year Student, Faculty of
Agriculture, EXIM Bank
Agricultural University
Bangladesh, Chapainawabganj,
Bangladesh

Redwan Amin

3rd Year Student, Faculty of
Fisheries and Ocean Sciences,
Khulna Agricultural University,
Khulna, Bangladesh

Fatema Jannat Raina

3rd Year Student, Faculty of
Fisheries and Ocean Sciences,
Khulna Agricultural University,
Khulna, Bangladesh

Md. Sohikul Islam

4th Year Student, Faculty of
Agriculture, EXIM Bank
Agricultural University
Bangladesh, Chapainawabganj,
Bangladesh

Corresponding Author:

Rabeya Akter

Lecturer, Department of Fishery
Biology and Genetics, Faculty of
Fisheries and Ocean Sciences,
Khulna Agricultural University,
Khulna, Bangladesh

Fish biodiversity and socioeconomic aspects of Beel fishing communities in the North-West of Bangladesh

Rabeya Akter, Md. Mahub Alam, Redwan Amin, Fatema Jannat Raina and Md. Sohikul Islam

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Abstract

The study was carried out to evaluate the existing fish biodiversity and the socioeconomic state of fishermen in the Charai, Bara beel, and Damas beel regions of the northwestern section of Bangladesh. A field survey was conducted in around 15 locations in the Gomostapur Upazila of Chapainawabganj district. A total of 44 different species of fish have been identified, including 16 common, 17 endangered, and 11 extinct. Five types of fishing gear were available, including a fish net, a fish trap, a hook, Fish Aggregation Devices (FAD), and wounding gear/spears. Illegal and overfishing with illegal fishing gear were identified as important issues in the research areas. Fishermen employed two types of boats: Chandni boats and Dinghi boats. Only 53.3% of the fisherman utilized their own boat, while the rest had no fishing vessels, which was a concerning issue in these areas. Though fishermen employed a variety of marketing strategies, the two-step marketing channel was adopted by half of them. Among the various types of issues confronting the fishermen, the most common was the injustice perpetrated by the local extortionist. The majority of the fishermen had medium fishing experience and a primary level of schooling. Most fishermen earned between 71,000 and 1,00,000 taka per year.

Keywords: Beel, fish biodiversity, fisheries, fishing gear

1. Introduction

The fisheries sector in Bangladesh has great potential to substantially impact the nation's socioeconomic development, economic recovery, reduction of poverty, employment opportunities, assurance of an adequate supply of food, and revenue from foreign exchange. This sector is crucial to the Bangladeshi economy. i.e. post-harvest activities include fish marketing, processing, distribution, and export, among other things (Haque *et al.*, 2021) [9]. The total fish production of Bangladesh in 2020-21 was 46.21 lakh MT. The fisheries sector made up 26.50% of the agricultural GDP and contributed 3.57% of the national GDP (DoF, 2022) [7]. Bangladesh develops to become a self-sufficient fish-producing nation that provides almost 60% of the daily requirement for animal protein. (BBS, 2016) [5]. Over 12% of the population makes a living from different activities that fall under the fishing sector (DoF, 2022) [7].

Bangladesh, as a riverine country, retains a substantial amount of water through its multiple channels, which include rivers, canals, estuaries, bays, haors, lakes, and so on. In Bangladesh, the most significant source for inland capture fisheries is beel (Islam *et al.*, 2021) [9]. In Bengali, a huge surface water body known as a "beel" is referred to as such because it collects surface water runoff through its internal water drainage channel (Rahman *et al.*, 2016) [17]. It also contains and passes a substantial volume of water connecting the river channel that ultimately flows into the sea (Khondoker *et al.*, 2014) [15]. A total of 114,161 ha, as well as 2.63% of the total inland fisheries, is thought to be covered by the beel and production is 104,871 metric tons. The average production from beel is 919 kg/ha, but it can be further enhanced (DoF, 2022) [7]. The fish production diversity of fisheries resources of inland open water fisheries of beels are 1.05 lakh MT and corresponding growth rates are 1.71%. The contribution of the total production of beels is 2.27% (DoF, 2022) [7]. The community of fishermen suffers from social, economic, and educational constraints as well as a lack of financial resources. The majority of Bangladesh's fishermen live in poverty, making them one of the country's most vulnerable communities (Ali *et al.*, 2009) [3]. Fishermen are typically low-income people, and fishing is viewed as a low-class occupation. Approximately 80% of rural families catch fish for personal use or sale (Halim *et al.*, 2017) [8].

In Bangladesh, the beel has a significant potential for in situ fish production. It has great contributions to the fisheries and socioeconomic well-being of fisher communities as well as the overall fishing community through income, employment opportunities, and support to less fortunate fisher communities. However, due to a lack of adequate management policy, inland open-water capture fisheries production has decreased in both quantity and species variety. As a result, approximately 54 small indigenous species among 260 freshwater species located in floodplains and beels, which are the primary food source for poor people, are on the verge of extinction (IUCN, 2000) [13]. That is why it is critical to understand the current state of fish and fisheries items. The

current study is, therefore, an attempt to evaluate the fish biodiversity and socioeconomic status of the fishing communities with various beels in Bangladesh's Chapainawabganj area.

2. Materials and Methods

2.1 Selection of the study area: The present study was conducted on the fisher community in 3 beels under Gomostapur Upazila, Chapainawabganj which is located in Bangladesh's northwestern region. Chapainawabganj is located between latitudes 24°22' and 24°57', and longitudes 87°23' and 88°23'. The name of the beels are Charail beel, Damus beel and Bara beel (Figure 1).

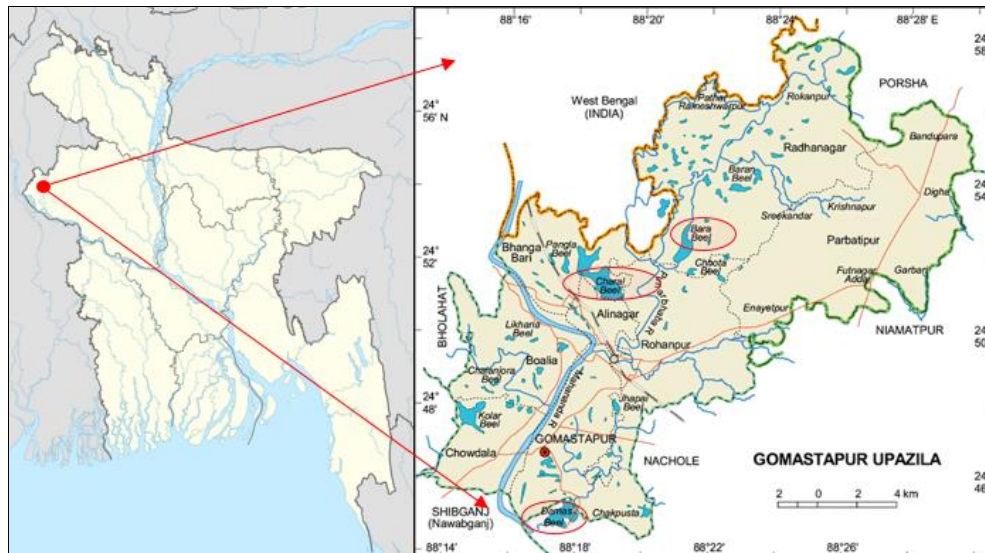


Fig 1: The location of the study area

2.2 Data collection procedure and analysis: This study was based on the collection of both primary and secondary data. First, primary data on the socioeconomic features of the fishing villages were gathered from the District Fisheries Officer (DFO), Chapainawabganj, Upazila Fisheries Officer (UFO), Gomostapur. Based on this data, an initial survey was carried out in the study area. A standard questionnaire was purposefully created, tested beforehand, and then finalized to gather data. Personal interviews with 45 fishermen from 15 villages were complemented by multiple approaches. Participatory Research Approach (PRA) tools include Focus Group Discussion (FGD) and Crosscheck Interviews (CI) with important sources at home near beel sites during fishing. During the interview, each respondent was given a brief description of the study's purpose. The survey was done based on fisherman type, age, education, experience, family size, house pattern, drinking water facility, sanitation, health, electricity, income, loan, training, religion, fishing net and gear used, fishing crafts, marketing channel, fishing time, fishing duration, amounts of fish caught, etc. Secondary data on the socioeconomic status of fishermen were acquired from publications, the quarterly and the annual reports made available by the Upazila Fisheries Office. The survey data was gathered, categorized, and evaluated in accordance with the objectives and specifications. Some of the information was numerical, while others were narrative. SPSS (Statistical Package for Social Science) and MS Excel 2016 were used to compile and evaluate all the data that had been gathered.

3. Result and Discussion

3.1 Socio-economic condition

3.1.1 Age structure: The distribution of fishers of the three beels according to age structure ranged from 20 years to 60 years. Based on age structure, the fishers were classified into three categories: “Young” (20-39 years), “Middle” (40-50 years), and “Old” (above 60 years). The maximum 40% of fishermen were Young and Middle-aged while the proportion of Old aged fishers was 20% of the total fishers (Table 1). According to Das *et al.* (2015) [6], the majority of fishermen in Bangladesh's southwest were between the ages of 16 and 30 (45%), while the minority were between the ages of 61 and 75 (4%). According to Halim *et al.* (2017) [8], of the fishermen that responded, 65.5% were between the ages of 25 and 34, 29.5% were between the ages of 35 and 55, and 5% were between the ages of 18 and 24. Age groups 20 to 35 years and 36 to 50 years had the largest percentages (37.5%), while those above 50 years had the lowest percentage (25%), as reported by Rahman *et al.* (2016) [17].

3.1.2 Education status and Fishing experience: The study categorized the respondent fishermen's education level into three categories: elementary, illiterate, and can only sign. The Primary group makes up most of the groupings, with 40%, followed by the Illiterate group with 33.3%, and the Can sign solely with 26.7% (Table 1). This study indicates that fishermen were mostly Primary level. Jahan *et al.* (2010) [14] reported that 45% of fishermen were illiterate, which was higher than the current figure. In the Eshulia Beel at Gouripur

Upazila, Mymensingh, it was discovered that 32.5% of people were illiterate, 40% could only sign, 15% had completed primary school, 7.5% had completed secondary school, 5% had completed higher secondary and above (Rahman *et al.*, 2016) [17]. In this study, a maximum of 46.7% of fishermen were experienced in fishing, ranging from 21 to 30 years (Table 1). Moreover, 13.3% have experience in fishing for 11–20 years, 13.3% have experience in fishing for 31–40 years, and 26.7% have none (Table 1).

3.1.3 Family size: The fishermen were divided into three groups based on the size of their families: small families (3–4), medium families (5–7), and large families (above 7). In terms of the total number of fishermen, the largest proportion (53.3%) had a medium family, while the lowest percentage (20%) had a large family (Table 1). According to Ali *et al.* (2009) [3], four to five family members made up more than half of the fish farmers in the Mymensingh region (45%).

3.1.4 House pattern: The house's structure was an indicator of the fishing communities' social standing. To the study, semi-paka homes made up 73.3% of fisherman's residences, whereas kacha homes made up 26.7% of all residences (Table 1). As reported by Alam (1995), just 6.66% of the Basantapur beel fishermen lived in paka households, whereas 82.22% of all home structures were kacha and 11.11% semi-paka. According to Rahman *et al.* (2016) [17], just 7.5% of fishermen in the Eshulia Beel had half-built structures, compared to 17.5% who had tin sheds and 75% who had kacha homes.

Table 1: Socio economic conditions of the beel community

Name of the Variable	Category	Percentage
Age	Young (20-39 years)	40.0
	Middle (40-59 years)	40.0
	Old (above 60 year)	20.0
Education	Illiterate	33.3
	Can sign only (<1 yrs)	26.7
	Primary (1-5yrs)	40.0
Fishing experience range in the year	Low Fishing experience (1-20 yrs)	40.0
	Medium Fishing experience (21-30 yrs)	46.7
	High Fishing experience (31-40yrs)	13.3
Family size	Small (3-4)	26.7
	Medium (5-7)	53.3
	Large (above 7)	20.0
House pattern	Mud-build	26.7
	Tin-shed	73.3
Drinking water facility	Own tube well	66.7
	Other's tube well	33.3
Sanitation facilities	Poor	33.3
	Moderate	53.3
	Developed	13.3
Health facilities	Village doctor	86.7
	Health community	13.3
Housing electricity facilities	Yes	100.0
Annual income	Low income (40,000-70,000)	13.3
	Medium income (71,000-1,00,000)	86.7
Credit availability	Received loan	80.0
	Didn't receive loan	20.0
Training	Trained	93.3
	Not trained	6.7
Fisherman type	Professional fishermen	53.3
	Seasonal fishermen	46.7

3.1.5 Drinking water facility: It was found that all fishing communities drank water from tube wells. About 66.7% of fishing communities had their own tube wells, and the remaining 33.3% made use of another tube well (Table 1). In Kafrikhal beel, Rangpur district, Bangladesh, Halim *et al.* (2017) [8] found that 100% of fishermen households utilized tube-well water for drinking and that among them, 65% used owned tube-wells and 35% used neighbor's tube-wells, which similar to the current findings.

3.1.6 Sanitation facilities: According to the findings of the current study, only 13.3% of the respondent fishermen have developed sanitary facilities, while 53.06% have moderate latrines and 33.3% have poor ones (Table 1). The outcome suggests that the respondent fishermen's hygienic situation is worrying. Additionally, according to Halim *et al.* (2017) [8], only 30% of Kafrikhal beel fishermen have constructed latrines. This could be brought on by low-income and community members' ignorance. According to Das *et al.* (2015) [6], the majority of fishermen (59%) in their study region used the Kacha toilet.

3.1.7 Health care facilities: The study showed that 86.7% of fisher communities were dependent on village doctors (unqualified practitioners), while 13.3% got health services from different health communities (Table 1). The fishermen's health facilities were poor, and they were reliant on village doctors who had little to no understanding of medical science. As reported by Roy *et al.* (2020) [19], 34.7% of the families of fishermen rely on kabiraji or Hakimi, 38% rely on palli chikitsoks, who are village doctors, and 27.3% seek medical attention from Upazila in the Shibs River in Bangladesh. According to Shahriar *et al.* (2010) [20], 64% of fishermen's households relied on village doctors for medical care, 24% went to the Upazila health complex, and the remaining 12% went to MBBS doctors in the Morgangi Beel in Jamalpur district.

3.1.8 Housing Electricity facilities: The current study finds that all of the respondents who are fishermen have access to proper housing and electricity (Table 1). According to Halim *et al.* (2017) [8], there were also no electricity facilities for the fishermen in Kafrikhal Beel, which is part of Mithapukur Upazila, Rangpur, Bangladesh. In the beels of North Western Bangladesh, Ahamed *et al.* (2020) [1] reported that only 35.11% of the respondent fisherman utilize electricity and 64.8% do not. The availability of electricity is a reliable indication of societal progress. A village's availability of electricity is a sign that it has developed or is still in the early stages of development. According to Shamima (2000) [21], 20% of fishermen in the fishing village of Gollamari utilize electricity in their homes.

3.1.9 Annual income: Based on the data from Table 1, 13.3% of fishing villages had medium incomes (Tk 40–70 thousand) and 86.7% had high incomes (Tk 70–100 thousand). In Bangladesh's Hajigonj upazila, Siddiq *et al.* (2013) [22] calculated the 61,375 BDT yearly income of professional fishers of the Dogger beel, which is closely similar to the income of Hilna beel fisherman. In the report by Hossain *et al.* (2014) [10], the annual revenue of fishers in Jelepura, Pahartali upazila, was 72000 BDT. The study's fishermen were found to be extremely underpaid, which paints a true image of the Bangladeshi fishing community.

3.1.10 Credit availability: There are numerous national and

local NGOs in the research region, including BRAC, Grameen Bank, Asha, Karithash, and TMSS. They only provided financing to impoverished fishing villages so they could purchase boats and fishing equipment. The study reveals that 20% of the respondent fishermen haven't taken a loan and they are financially self-sufficient, on the other hand, 80% have taken a loan (Table 1).

3.1.11 Training about fishing: Many people use fishing as a source of money and a means of subsistence, but it may turn into a nightmare if not handled carefully. This study was necessary in order to identify the areas in which fishermen need training in order to improve their fishing efforts. It was found that 93.3% of fishers didn't take any training about fishing. Only 6.7% got trained in fishing which was very low (Table 1). The outcome shows that the respondent fishermen's level of training is being concerned. According to Halim *et al.* (2017) [8], out of the 80 fisher villages that were surveyed, 25.5% of respondents received socioeconomic training, while 74.5% did not. In the Mymensingh region, over 49% of farmers have received official training in prawn farming.

3.1.12 Fisherman type: In the current survey, it was shown that 53.3% of fishermen are professionals who rely on fishing

for their livelihoods practically year-round and 46.7% are seasonal professionals who capture fish for a living during a specific time of the year (Table 1).

3.2 Fishing gear used by the fisherman

There are some fishing gears that are designed specifically for certain species of fish, while others are more generalized. The fishing gear found in the study area was classified into five types, namely fish net, fish trap, hook, FAD (Fish Aggregation Devices), and wounding gear/Spears. During the study period, 7 types of fishing gear were observed for fishing in a single day. Several forms of nets and gears have been used in the different beels under the Gomostapur Upazila in Chapainawabganj, Bangladesh by the fishers such as Berial net, Jhakijal net, Bittechai trap, Chipborsi hook, Charaborsi hook, spear, FAD, etc. Only two different kinds of nets, one kind of trap, two different kinds of hooks, one kind of spear, and numerous FAD were found. Most of the gear was traditional, and some of it was local only. About 33.30% of fishermen used Jhakijal nets, while just 4.40% of fishing communities used spears (Figure 2). As reported by Ara *et al.* (2010) [4], the Beel Dakatia catch fishery in the Khulna region used around seven different types of gear, eight different types of traps, and five different types of hooks and spears.

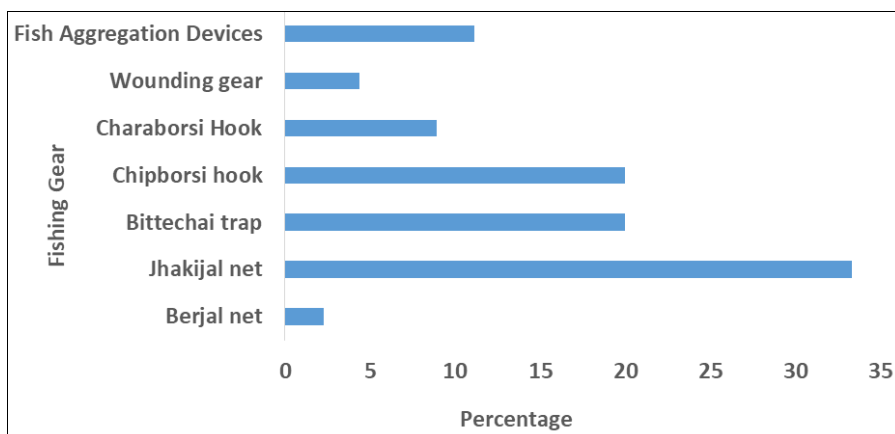


Fig 2: Name of the fishing gears used by the fisherman of the study area

3.3 Fishing crafts used by the fisherman

The boat is absolutely necessary for fishermen to gather fish for commercial purposes as a fishing craft. In the research area, fishermen used Chandni Nouka and Dinghi Nouka to catch fish. But a major portion of fishers hadn't any nouka for fishing and harvesting. The study reveals that 46% of people

had no crafts for fishing and 47% of people used Dinghi Nauka. About 7% of people used Chandni Nauka. But mostly used crafts were Dinghi Nauka. But 46.7% of people had no fishing crafts for fishing which was an alarming issue for those fishermen (Figure 3).

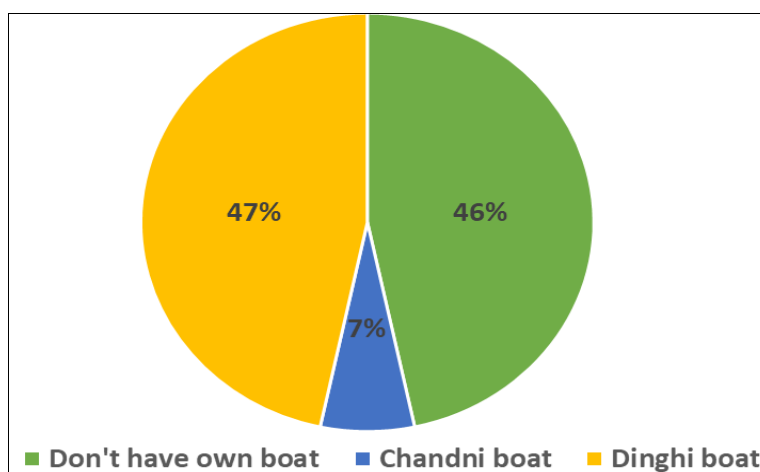


Fig 3: Types of crafts used by fishermen

From the study, it was seen that 53.3% of fishers used their boat and 46.7% of fishers weren't able to purchase their boats. They borrowed boats from another person. Most of the studied fishermen are very poor. So, around half of them can't able to purchase their own boat.

3.4 Fish species found in the study area

In various beels during the study period, 14 species of fish were discovered, 12 of which were extinct or endangered (Table 2). When dominating fish were once common, they eventually became extremely rare or became extinct.

Table 2: Different types of fish species listed in Charai beel, Barabeel and Damas beel

	Local Name	Common Name	Scientific Name
Available fish species	Tengra	Batasio	<i>Batasio batasio</i>
	Kuchia	Swamp eel	<i>Monopterusuchia</i>
	Puti	Swamp barb	<i>Puntiuschola</i>
	Taki	Spotted sank head	<i>Channa punctata</i>
	Prawn	Beel chingri	<i>Macrobrachium dayaman</i>
	Rui	Rui	<i>Labeo rohita</i>
	Catla	Catla	<i>Labeo catla</i>
	Mrigal	Mrigal	<i>Cirrhinus cirrhosus</i>
	Mirror carp	Mirror carp	<i>Cyprinus carpio</i>
	Koi	Climbing gourami	<i>Anabas cobojius</i>
	Shol	sanke head murrel	<i>Channa striata</i>
	Murari	carplet fish	<i>Aspidoparia morar</i>
	Kholisha	Dwarf gourami	<i>Colisa lalia</i>
	Shing	Stinging catfish	<i>Heteropneustes fossilis</i>
	Bata	Bata	<i>Labeo bata</i>
	Baila	Tank goby	<i>Awaous guamensis</i>
Endangered fish species	Chanda	Glassy perchlet	<i>Brama brama</i>
	Bacha	Bacha	<i>Eutropiichthys vacha</i>
	Khori	Khoyra	<i>Chatoessus manminna</i>
	Baim	Zigjag eel	<i>Mastacembelus armatus</i>
	Raikhor	Reba carp	<i>Cirrhinus reba</i>
	Kachki	Ganga river-sprat	<i>Corica soborna</i>
	Batasi	Indian potasi	<i>Pseudeutropius atherinoides</i>
	Chola punti	Chola barb	<i>Puntius chola</i>
	Ghonia	Kuria labeo	<i>Labeo goniis</i>
	Magur	Walking catfish	<i>Clarias batrachus</i>
	Chitol	Clown knifefish	<i>Chitala chitala</i>
	Pabda	Indian catfish	<i>Ompok pabda</i>
	Gojar	Great snakehead	<i>Channa marulius</i>
	Kakila	Freshwater garfish	<i>Xenentodon cancila</i>
	Baghair	Gangetic goonch	<i>Bagarius yarrelli</i>
	Boal	Freshwater shark	<i>Wallago attu</i>
Potka	Ocellated pufferfish	<i>Tetraodon cutcutia</i>	
Extinct fish species	Khori	Khoyra	<i>Chatoessus manminna</i>
	Magur	Walking catfish	<i>Clarias batrachus</i>
	Mola	Mola carplet	<i>Amblypharyngodon microlepis</i>
	Shol	Sanke head murrel	<i>Channa striata</i>
	Baila	Gobyfish	<i>Awaous guamensis</i>
	Pabda	Indian catfish	<i>Ompok pabda</i>
	Baim	Zigjag eel	<i>Mastacembelus armatus</i>
	Guchi	barred spiny eel	<i>Macroglyphus pancalus</i>
	Bacha	Bacha	<i>Eutropiichthys vacha</i>
	Orange fin rui	Kalbasu	<i>Labeo calbasu</i>
Veda	Mottled nandus	<i>Nandus nandus</i>	

3.5 Fishing times, duration, and amount

From the study, we found that 45.50% of fishermen caught fish from the evening to dawn. Of the remaining fishermen, about 27.30% caught fish from morning to noon, and also 27.30% caught fish from noon to evening (Table 3). The most suitable time for fishing in the beels among responded fishers was from evening to dawn. From the survey, 77.80% of fishers

were involved in fishing for 3 to 4 hours, and 22.20% of fishers were engaged in fishing for 1 to 2 hours. It was found that the maximum number of responded fishers were engaged in fishing for 3 to 4 hours. We also found that most of the fishers (44.80%) caught around 2 to 4 kg fishes per day. 41.40% of fishers caught fish around 4 to 6 kg per day. The lowest amount of fishes, around 1 to 2 kg were caught by 13.80% (Table 3).

Table 3: Fishing time, duration and the quantity of fish captured in three beel

Fishing time	Categories	Percent
	Morning to noon	27.30%
Noon to evening	27.30%	
Evening to dawn	45.50%	
Duration of fishing	1 to 2 hours	22.20%
	3 to 4 hours	77.80%
Amount of fish captured	1 to 2 kg	13.80%
	2 to 4 kg	44.80%
	4 to 6 kg	41.40%

3.6 Marketing Channels

According to the study's findings, there were several middlemen in the market chain between fishermen and customers. In every stage of the marketing chain, all market participants, but notably intermediaries, made a considerable

profit. In the research area, there were two different kinds of fish marketing channels. 50% of Fishers sold fish directly to customers in a two-step marketing channel, while the remaining 25% sold fish to retailers, who then sold fish to consumers in a three-step marketing channel (Figure 4).

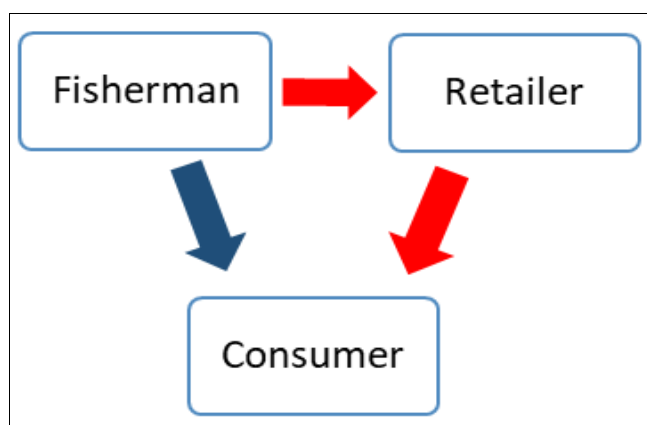


Fig 4: Types of marketing channels

3.7 Problems faced by the fishermen

This study found that 30.60% of fishermen had been treated unfairly by local extortionists who asked for too much money or bribes. Also, 25% of fishermen had trouble because they could not get enough credit (Table 4). This made it hard for them to buy new fishing gear and grow their businesses. About 16.70% did not have enough fishing gear and had

trouble because of robbers, thieves, and other bad people. Also, 8.30% of them live in poverty and use credit to buy important fishing gear, which adds to their financial problems. About 13.9% of fishermen did not know how to read or write and lived from hand to mouth. Also, 5.60% of them had to deal with natural disasters every year, which made it harder for them to fish.

Table 4: Problems faced by the fishermen

Problems	Percentage
1 The injustice by the local extortionist	30.60%
2 Inadequate credit facilities	25.00%
3 Lack of fishing gear and disturbances by bandits, thieves etc.	16.70%
4 Dependence on credit for buying net and other fishing equipment	8.30%
5 Lack of proper education and training illiterate	13.90%
6 The incidence of natural calamities	5.60%

4. Conclusion

The study of the socioeconomic circumstances of fishing communities and the status of biodiversity in the beels of this region provides valuable insights that can facilitate the development of sustainable fisheries management strategies and the improvement of the quality of life of fishing communities. In order to ensure the sustained welfare of fish populations and fishing communities, it is imperative that further investigation and collaborative endeavors be undertaken to tackle the challenges and implement efficacious remedies. Some beel management strategies should be put into place in order to protect the species that are close to becoming extinct and to restore sustainable beel production. In order to safely maintain biodiversity, it is crucial to identify

distinct regions where fish are able to move freely (i.e., ex-situ) and to refrain from conducting intensive fishing activities in those areas. Furthermore, it is imperative to safeguard mother fish, restrict fishing during egg-laying and fry stages, exercise prudence in the application of pesticides in agricultural settings, and prohibit the utilization of contemporary fishing nets. Leasing should be avoided which is one of the major threats to hampering the biodiversity in the beels. In order to properly maintain the wide variety of fish species found in these beels, fishermen must gain knowledge and awareness of the Community Based Fisheries Management (CBFM) strategy and sustainable fisheries management methods.

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